CLAIMS

What is claimed is:

1. A method of removing arsenic from water, comprising:

adding magnesium hydroxide to the water;

adsorbing arsenic on the magnesium hydroxide; and

separating and removing from the water the magnesium hydroxide with adsorbed arsenic, whereby substantially arsenic-free water is produced.

2. The method of claim 1, wherein adding magnesium hydroxide to the water comprises adding magnesium oxide, which converts to magnesium hydroxide upon contact with the water.

3. The method of claim 2, wherein the magnesium oxide comprises reactive magnesium oxide.

4. The method of claim 2, wherein a sufficient amount of magnesium hydroxide is added to the water to reduce the concentration of arsenic to below 10 ppb.

5. The method of claim 2, wherein a sufficient amount of magnesium hydroxide is added to the water to reduce the concentration of arsenic to 2 ppb.

6. The method of claim 1, wherein the water is wastewater from an industrial process.

7. The method of claim 1, wherein the water is potable water.

8. The method of claim 1, wherein the magnesium hydroxide is used in a form selected from the group consisting of a suspension, a slurry, powders, and particulates.

9. The method of claim 8, wherein the magnesium hydroxide has a median particle size less than 3 microns.

10. The method of claim 9, wherein the magnesium hydroxide has a median particle size of 0.5-1 microns.

11. The method of claim 8, wherein the magnesium hydroxide powder has a surface area of 7-13 m^2/gram.

12. The method of claim 1, wherein the step of adding magnesium hydroxide to the water comprises using a injector selected from the group consisting of a powder injector and a suspension injector to inject material into a flowing stream of the water.

13. The method of claim 1, wherein the step of adsorbing arsenic on the magnesium hydroxide comprises maintaining the magnesium hydroxide in contact with the water for less than approximately one hour.

14. The method of claim 13, wherein the step of adsorbing arsenic on the magnesium hydroxide comprises maintaining the magnesium hydroxide in contact with the water for less than approximately thirty minutes.

15. The method of claim 13, wherein the step of adsorbing arsenic on the magnesium hydroxide comprises maintaining the magnesium hydroxide in contact with the water for approximately 2 minutes.

16. The method of claim 13, wherein the step of adsorbing arsenic on the magnesium hydroxide comprises stirring the mixture of water and magnesium hydroxide to keep the magnesium hydroxide in suspension for a sufficient period of time to adsorb a sufficient amount of arsenic.

17. The method of claim 2, wherein adding magnesium hydroxide to the water comprises adding 0.001-10 grams of MgO to each liter of water to be treated.

18. The method of claim 1, wherein adding magnesium hydroxide to the water comprises adding 0.001-10 grams of $Mg(OH)_2$ to each liter of water to be treated.

19. The method of claim 17, wherein adding magnesium hydroxide to the water comprises adding 0.1-0.5 grams of MgO to each liter of water to be treated.

20. The method of claim 18, wherein adding magnesium hydroxide to the water comprises adding 0.1-0.5 grams of $Mg(OH)_2$ to each liter of water to be treated.

21. The method of claim 1, wherein separating the magnesium hydroxide with adsorbed arsenic from the water comprises using a separation method selected from the group consisting of filtering, settling, skimming, vacuuming, draining, dissolved air flotation, vortex separating, centrifuging, and a combination of two or more of the foregoing.

22. The method of claim 21, further comprising using a flocculating agent to aid the settling process.

23. The method of claim 1, wherein the magnesium hydroxide is disposed on the surface of a carrier particle.

24. The method of claim 23, wherein the carrier particle is lighter than water.

25. The method of claim 24, wherein the carrier particle is selected from the group consisting of a plastic microsphere and a polystyrene microsphere.

26. The method of claim 23, wherein the carrier particle is heavier than water.

27. The method of claim 26, wherein the carrier particle is selected from the group consisting of a sand particle and a glass microsphere.

28. The method of claim 23, wherein the carrier particle is magnetic.

29. The method of claim 28, further comprising magnetically separating the magnetic carrier particle from the water.

30. The method of claim 1, further comprising adjusting the pH of the water after separating and removing the magnesium hydroxide with adsorbed arsenic from the water.

31. The method of claim 1, wherein the water comprises carbonate.

32. The method of claim 31, wherein the $Mg(OH)_2$ is permitted to adsorb arsenic for a period of time, wherein the period of time is sufficiently long to allow substantially all the arsenic to adsorb to $Mg(OH)_2$; and wherein the period of time is sufficiently short to prevent significant release of the arsenic from the $Mg(OH)_2$ with adsorbed arsenic, due to conversion of $Mg(OH)_2$ to $MgCO_3$ by the carbonate in the water.

33. The method of claim 31, wherein the step of adding magnesium hydroxide to the water is performed in association with a water softening process that removes

carbonate from the water by adding a compound that causes precipitation of $CaCO_3$ from the water.

34. The method of claim 31, wherein the step of adsorbing arsenic on the magnesium hydroxide comprises increasing the pH level to decrease the rate of formation of $MgCO_3$.

35. The method of claim 31, further comprising the step of adding an inhibitor to inhibit conversion of magnesium hydroxide to magnesium carbonate.

36. The method of claim 35, wherein the inhibitor is a reagent selected from the group consisting of CaO and NaOH.

37. The method of claim 35, wherein the inhibitor increases the pH of the water.

38. The method of claim 31, wherein the step of adding magnesium hydroxide to the water further comprises:

considering the rate of arsenic adsorption to magnesium hydroxide;

considering the rate of loss of magnesium hydroxide due to conversion of magnesium hydroxide to magnesium carbonate; and

considering the rate of arsenic release resulting from said conversion of magnesium hydroxide to magnesium carbonate.

39. A continuous process for removing water arsenic from water and for recycling magnesium, comprising:

a) adding magnesium oxide to the water, whereupon it converts to magnesium hydroxide;

b) adsorbing arsenic on the magnesium hydroxide;

c) separating and removing from the water the magnesium hydroxide with adsorbed arsenic, whereby substantially arsenic-free water is produced;

d) making an aqueous solution comprising the magnesium hydroxide with adsorbed arsenic removed in step c);

e) converting the magnesium hydroxide with adsorbed arsenic to magnesium carbonate, whereupon free arsenic is released into the solution;

f) separating and removing the magnesium carbonate from the solution; and

g) heating the magnesium carbonate to produce carbon dioxide and purified magnesium oxide; and

h) providing the purified magnesium oxide produced in step g) to step a), whereby the magnesium is recycled.

40. The method of claim 39, wherein converting the magnesium hydroxide to magnesium carbonate in step e) comprises exposing the magnesium hydroxide to an aqueous solution comprising a reagent selected from the group consisting of sodium carbonate, sodium bicarbonate, potassium carbonate and potassium bicarbonate.

41. The method of claim 39, wherein the magnesium carbonate is heated in step g) to at least about 400 C.

42. The method of claim 39, further comprising converting the produced magnesium oxide to a powder of a desired size in-between step g) and h).

43. The method of claim 39, further comprising, after step e), removing arsenic from the solution comprising free arsenic, whereby purified arsenic is produced.

44. A method of removing arsenic from water, comprising:

adding calcium hydroxide to the water;

adsorbing arsenic on the calcium hydroxide; and

separating and removing from the water the calcium hydroxide with adsorbed arsenic, whereby substantially arsenic-free water is produced.

45. The method of claim 44, wherein adding calcium hydroxide to the water comprises adding calcium oxide, which converts to calcium hydroxide upon contact with the water.

46. A method of concentrating arsenic from a sample of arsenic contaminated water, comprising:

a) adding magnesium hydroxide or magnesium oxide, which converts to magnesium hydroxide upon contact with water, to a first sample of water;

b) adsorbing arsenic on the magnesium hydroxide;

c) separating and removing from the first sample the magnesium hydroxide with adsorbed arsenic;

d) adding the magnesium hydroxide with adsorbed arsenic removed in step c) to a second sample of water, wherein the volume of the second sample is less than the volume of the first sample; and

e) converting the magnesium hydroxide with adsorbed arsenic in the second sample to magnesium carbonate, whereupon free arsenic is released into solution; whereby the concentration of free arsenic in the second sample is concentrated relative to the first sample by the ratio of the volume of the first sample divided by the volume of the second sample.

47. The method of claim 46, wherein the ratio of the volume of the first sample divided by the volume of the second sample is greater than or equal to 10.

48. The method of claim 46, further comprising measuring the concentration of arsenic in the second sample, and then dividing by the ratio of the volume of the first sample divided by the volume of the second sample, to produce the true concentration of arsenic in the first sample.

49. The method of claim 46, wherein step e) comprises adding to the second sample a carbonate reagent selected from the group consisting of sodium carbonate, sodium bicarbonate, potassium carbonate and potassium bicarbonate.